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ESTABLISHMENT REPORT
SITKA SPRUCE WEEVIL TREND PLOTS
SOLEDUCK DISTRICT, OLYMPIC NATIONAL FOREST, WASHINGTON

By

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The Sitka spruce weevil causes more damage to Sitka spruce reproduction in the Pacific Northwest than any other insect. ^{1/} By attacking and killing terminal shoots, weevils can cause significant height growth loss and deformation of the main stem. In mixed spruce-hemlock stands, hemlock sometimes assumes stand dominance following severe weeviling of the spruce. Trees from about 8 to 30 years old and up to 50 feet in height are most susceptible. Spruce that is weeviled for several successive years often takes on a bush-like appearance. ^{2/}

The overall impact of Sitka spruce weevil damage on the composition and character of future spruce stands is not known. However, damage has been so heavy in some areas along the coasts of Washington and Oregon that Sitka spruce is no longer planted. ^{3/}

In 1964, a series of Sitka spruce weevil trend plots were established on the Olympic National Forest in Washington. The purpose of these plots was to test methodology in measuring trend. The Olympic National Forest was chosen because it is the most northwestern point in the continental United States where Sitka spruce grows naturally. The main purpose of spruce weevil trend plots is to determine: (1) Severity of the spruce weevil problem in coastal spruce stands and, (2) variability of damage by locality.

^{1/} Keen, F. P., 1938 (rev. 1952). Insect enemies of our western forests. U. S. Dept. of Agriculture, Misc. Pub. 273, 280 pp., illus.

^{2/} Wright, K. H., 1960. Sitka spruce weevil. Forest pest leaflet 47, U. S. Dept. of Agriculture, Forest Service, 6 pp.

^{3/} Keen, F. P. 1938 (rev. 1952). Op. Cit.

Data from these plots should help determine whether damage is significant enough to warrant control. If control is justified, then studies to determine control methods should be promoted whether they be biological, chemical, or silvicultural.

Objectives

1. To determine annual and accumulative Sitka spruce weevil damage.
2. To determine if weevil damage varies by distance from the ocean.
3. To determine if weevil damage varies with latitude.

Methods

In July 1964, potential Sitka spruce weevil trend plot locations were examined on the Soleduck District, Olympic National Forest. A map prepared by the District showing all recent spruce plantations and year of establishment was very helpful in locating these areas. Ideally, plots should be established in a series of plantations that have the following characteristics: (1) Stand composition primarily spruce between 5 and 10 feet in height and (2) locations at three different distances from the ocean at the same latitude; i.e., one plot next to the ocean, one plot at the eastern limit of spruce and one plot in between. On the Soleduck District, the first characteristic was easily fulfilled; however, the second was impossible to satisfy. The Strait of Juan de Fuca borders the northern edge of the Forest, so the marine effect comes from the north as well as the west.

Three plantations were suitable for plot locations. These areas were near Bigler Mountain, the North Fork of the Calawah River and the Calawah Work Center (see attached plot location maps). At the time of establishment, the following data were collected for each plot:

- | | |
|-------------------------------|------------------------|
| 1. Average age of spruce | 4. Origin of stand |
| 2. Aspect | 5. Distance from ocean |
| 3. Percent of stand in spruce | 6. Elevation |

At each plot a center line was run using a staff compass and chain. Posts were established along the center line at 50-foot intervals. On the Bigler Mountain and Calawah Work Center plots, all spruce over 3 feet in height within 15 feet of either side of the center line were tagged until 100 trees were obtained. On the North Fork Calawah River plot, all spruce over 3 feet in height within 7.5 feet of either side of the center line were chosen. Trees were more dense on the latter area.

The following data were taken for each tagged tree:

1. Height
2. Number of past weevilings
3. Type and cause of present terminal damage, if any.

Installation Results and Discussion

All three plots were established in spruce plantations located on flat areas. Distance from the ocean did not differ significantly between plots because of the Strait of Juan de Fuca, and latitude was similar. Elevation of the areas ranged from 440-940 feet (Table 1). Although only spruce was planted at the plot sites, other species--primarily western hemlock--have become well established on the Calawah Work Center and Bigler Mountain plots. The North Fork Calawah River plot remains an almost pure spruce stand. Average age of the stands did not vary greatly; only three years separate the youngest and oldest plantations. Trees on both the Bigler Mountain and North Fork Calawah River plots averaged 6.0 feet in height with a range of 3 to 11 feet on the former and 3 to 12 on the latter. Trees on the Calawah Work Center plot were noticeably taller--averaging 8.9 feet and ranging from 4-21 feet.

Table 1.--Summary of data gathered during establishment of three
Sitka spruce weevil trend plots on the Soleduck District,
Olympic National Forest, Washington, July 1964

	: Bigler Mtn.	: N. Fork : Calawah River	: Calawah Work : Center
Ave. age of spruce	11 years	12 years	14 years
Aspect	Flat	Flat	Flat
Percent of stand in spruce	70%	100%	50%
Origin of stand	Planted 1955	Planted 1954	Planted 1952
Distance from Ocean	11 air miles	14 air miles	14 air miles
Elevation	940 feet	645 feet	440 feet
Ave. height of plot trees	6.0 feet	6.0 feet	8.9 feet
No. trees weeviled in 1963	0	4	0

Weevil damage was found on only the North Fork Calawah River plot. In 1963, 4 of the 100 plot trees were weeviled. Examinations this year were too early to detect 1964 weeviling. No weevil damage prior to 1963 was seen on any of the three plots.

Two other types of terminal damage were seen on the plot trees in all three areas. In one type of damage, the terminal bud never bursts, thus causing a lateral or several laterals to assume apical dominance. The result is either a crooked bole and/or a multiple-leadered tree. In the second type of damage, the terminal bud bursts, and the terminal shoot elongates for 6-12" then dies. Effect on tree form is the same as that of the first type of damage. These types of damage might be caused by the spruce bud moth, Zeiraphera ratzeburgiana, or the moth, Epinotia hopkinsana. In 1964, six trees on the three plots exhibited the first type of damage and one tree the second type. Several trees adjacent to the plots also exhibited these characteristics. Chermes cooleyi galls were also found on several of the trees in each area. On some trees, over 50 percent of the lateral shoots were deformed by galls.

Spruce forms multiple leaders from causes other than weeviling. Whipping and suppression sometimes kill terminal shoots. Crooks in the main stem may result when a tree bends to grow around slash or another tree. As previously stated, other insects can cause similar damage. Personnel rating plot trees should be careful in separating weevil damage from other damage. If the remnants of a weeviled leader can be found in the affected whorl, the deformation is undoubtedly caused by the spruce weevil.

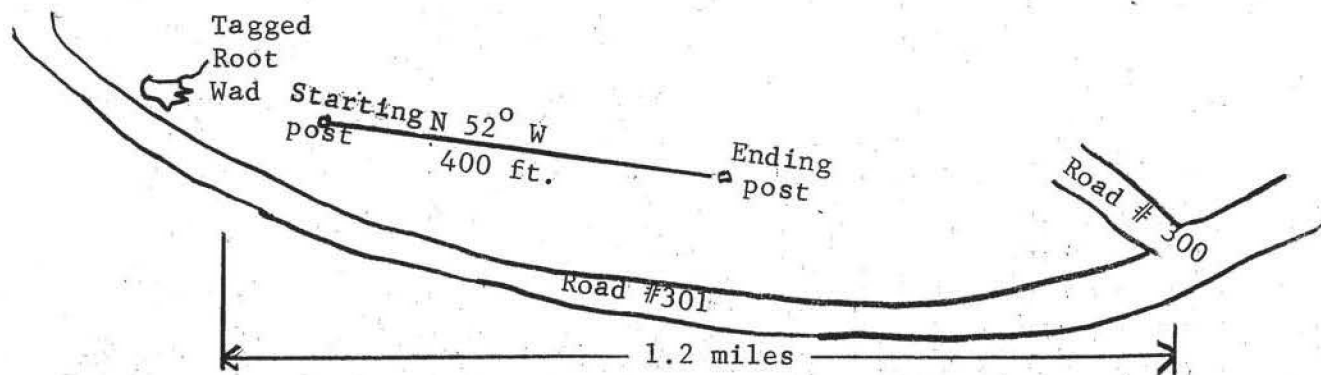
Time required for two men to scout and establish the three trend plots was 4 days including travel to and from Portland. A two-man crew should be able to make annual evaluations of these plots in 3 days including travel to and from Portland. At this time, they should check only for terminal damage and do any necessary plot maintenance.

Recommendations

1. Trees on the three plots on the Soleduck District, Olympic National Forest should be examined annually for terminal damage for at least the next 5-10 years.
2. Height growth should be measured every 5 years and analyzed with the terminal damage data to see what major effect weeviling has on tree height.
3. Similar plots should be established in other young Sitka spruce stands in coastal Washington and Oregon to determine the extent and severity of weevil damage throughout the Region.

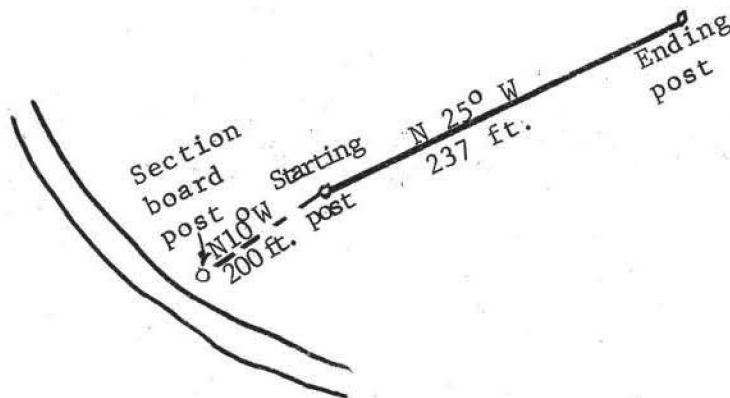
Bigler Mtn. Sitka Spruce Weevil Plot--Sec.34;T.30N.;R.11W.

From Forks, Wn. travel about 18 miles towards Port Angeles on U.S. Hwy. 101. Turn right (south) directly across from U.S.F.S. Klahowya Camp Grounds on road #300. After crossing Kugel Cr. turn onto road #301 and proceed 1.2 miles from junction to plot post on right (west) side of road. An aluminum flasher on a burned root next to the road marks the plot. The starting post is about 25 feet west of the marked root. The line runs for 400 feet at a true bearing of $N52^{\circ}W$. Stakes have been placed every 50 feet. All spruce trees over 3 feet in height within 15 feet of either side of the center line were tagged until 100 trees were obtained.



North Fork Calawah River Sitka Spruce Weevil Plot--Sec.14;T.29N.;R.12W.

From Forks, Washington proceed about 18 miles towards Port Angeles on U.S. Hwy. 101. Turn right (south) on F.S. Road #300 directly across from Klahowya Camp and proceed for 5.3 miles until the Snider-Calawah Rd. Junction. Turn right (west) on this road and proceed 0.8 mile to a section board on the right (north) between sections 13 and 14. The plot starting post is $N10^{\circ}W$ about 200 ft. from the section board post. The line runs for 237 ft. and all spruce over 3 ft. in height within 7.5 ft. of either side of the center line were tagged until 100 trees were obtained. Posts have been placed at 50-foot intervals along the line.



Calawah Work Center Sitka Spruce Weevil Plot--Sec.6;T.28N.;R.12W.

From Forks, Wash. go 1.6 miles north on U.S. Hwy. 101 to Forest Service Road #296 on the right (east) side of the road (immediately before State Dept. of Natural Resources scaling station). Turn right (east) on this road and proceed 5.2 miles to a post on the left (north) side of the road 0.1 mile past the Calawah Work Center. Post is at the side of the road but may be hidden with ferns. A path has been brushed out to the starting post. The line runs 225 feet at a true bearing of $N55^{\circ}E$. Every spruce over 3 feet high within 15 feet of either side of the center line was tagged until 100 trees were obtained. Center posts were placed at 50-foot intervals.

